

Relativistic Electron Response to the January 1997 Magnetic Cloud

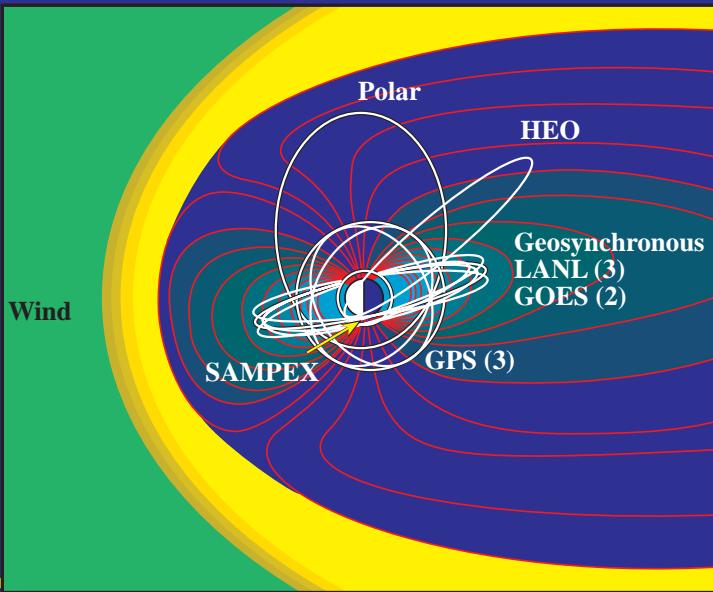
Reeves, Baker, Belian, Blake, Cayton, Fennell, Friedel,
Henderson, Kanekal, Li, Meier, Onsager, Selesnick, Spence

Outline:

- Global relativistic electron response
- New model for flux variations
vs time and L-shell

Reeves et al., JGR submitted

- Substorm response to cloud passage
- Geosynchronous relativistic electrons
- Comparison to other events
- Geosynchronous data synthesis model



**January 1997 Magnetic Cloud
E > 2 MeV Electrons from 5 Geosynchronous Satellites**

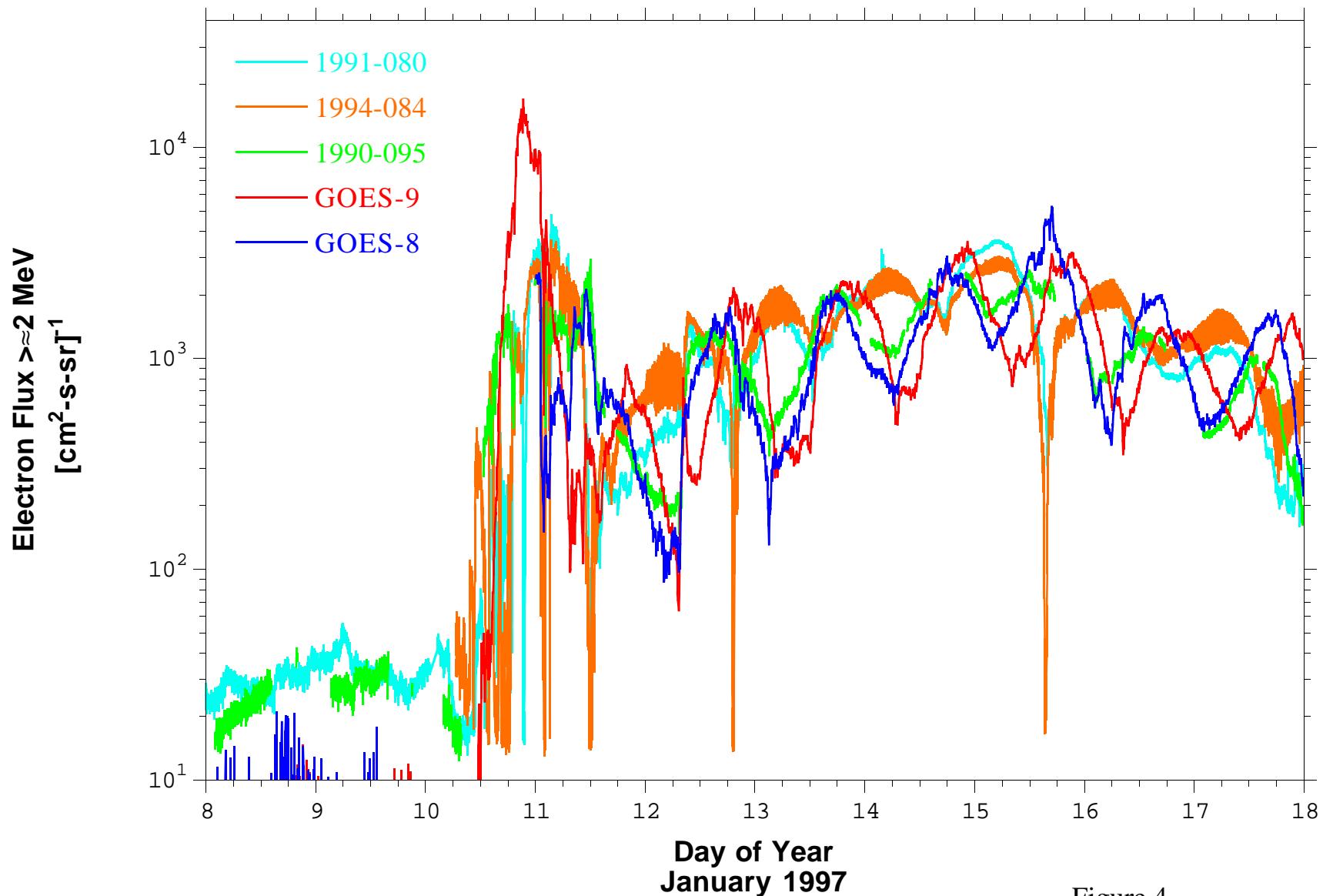
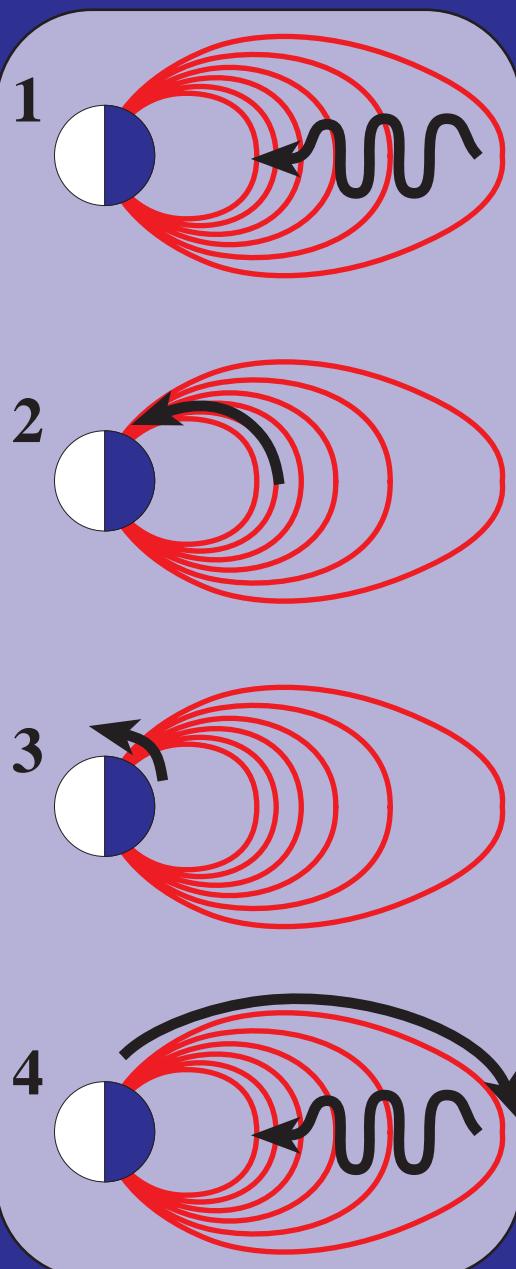


Figure 4
Reeves et al., JGR, 1997



The Recirculation Model

Developed to Explain:

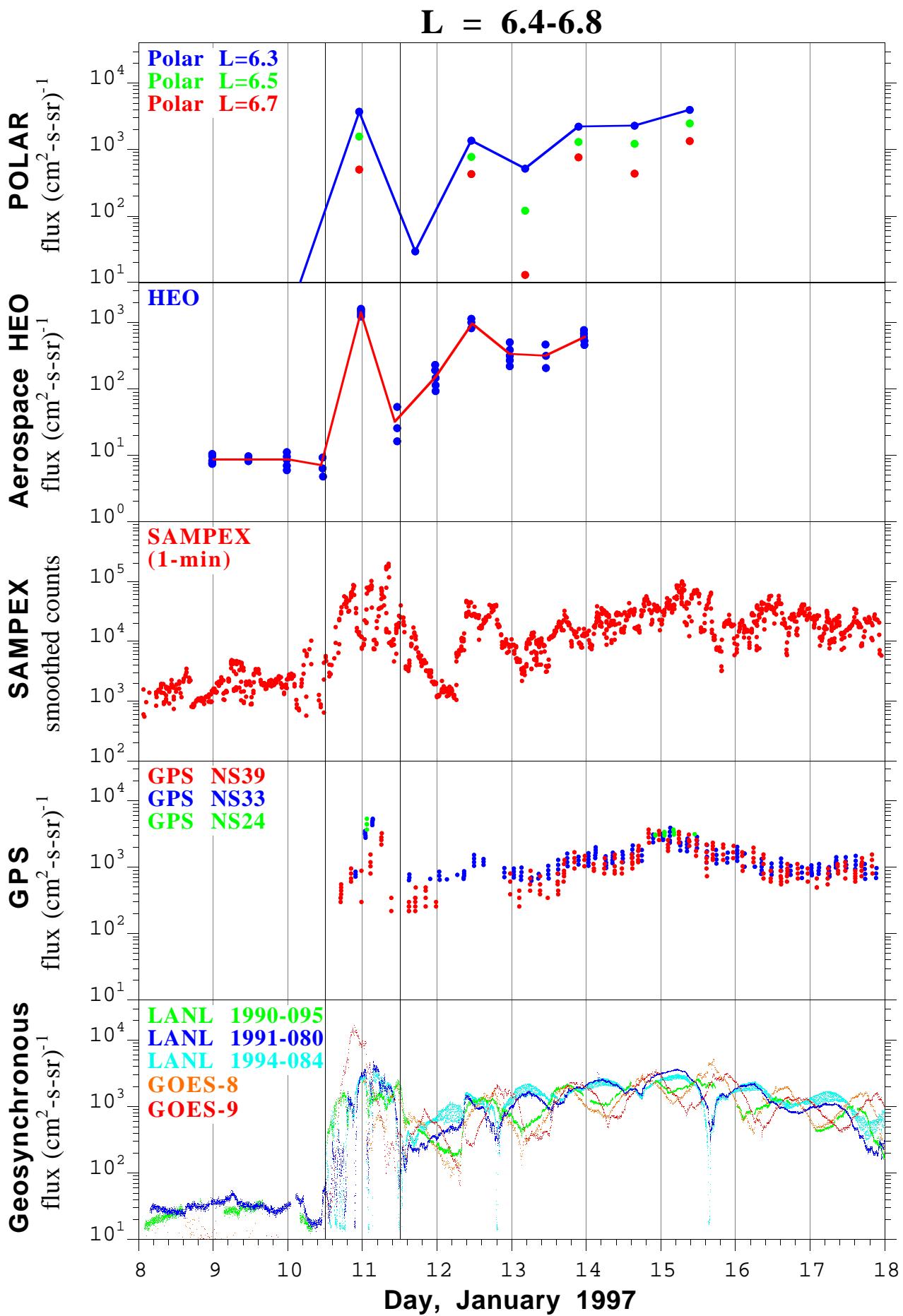
- Acceleration to high energy
- Delay of peak at geosynchronous
- Increasing delay with energy

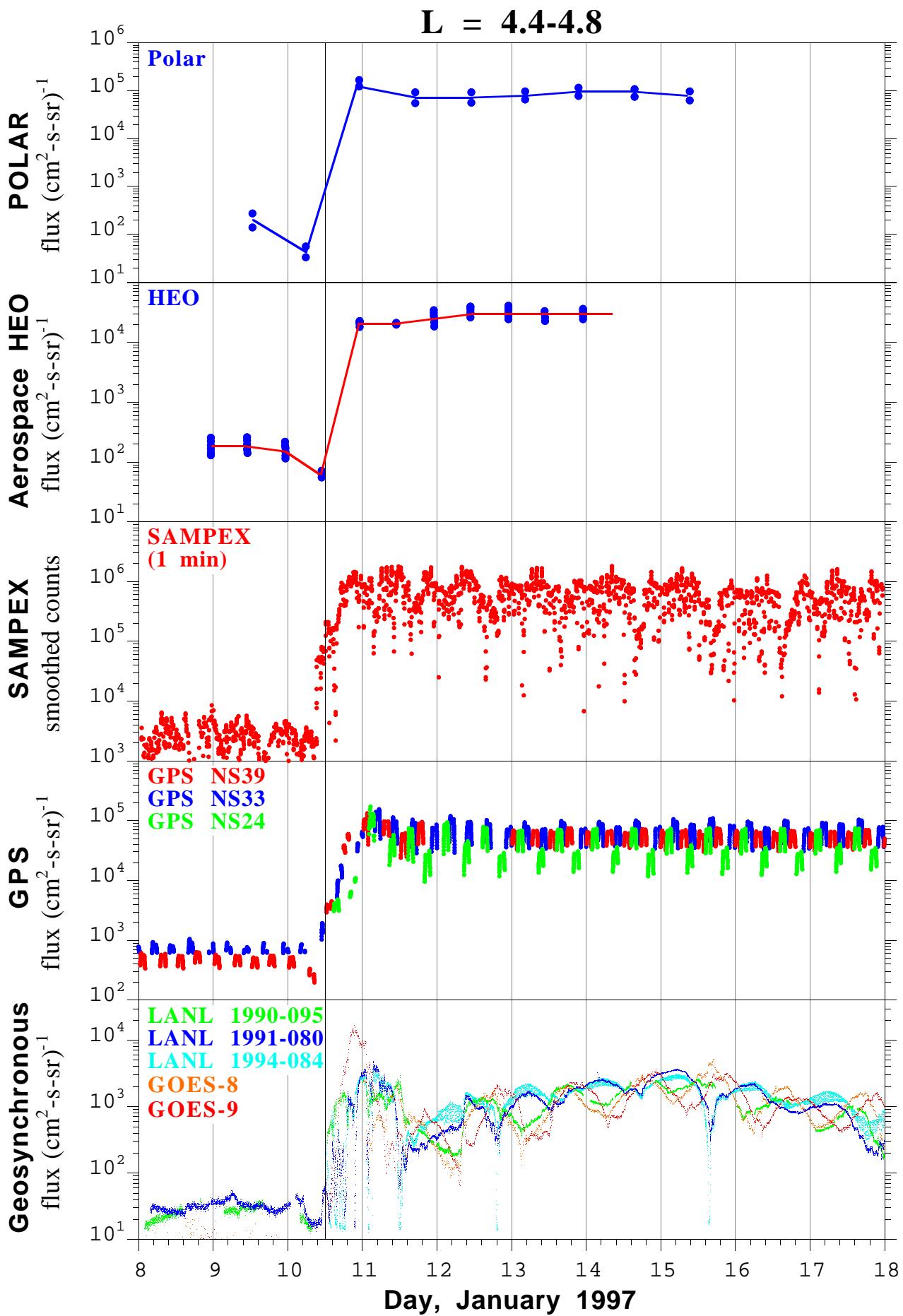
Characteristics:

- Buildup of fluxes is slow (2-6 days)
- Fluxes vary simultaneously at all L
- Source is outside geosynchronous

Problems:

- Unknown processes especially step 3
- Acceleration continues after SW disturbance
- Can't explain multiple peaks





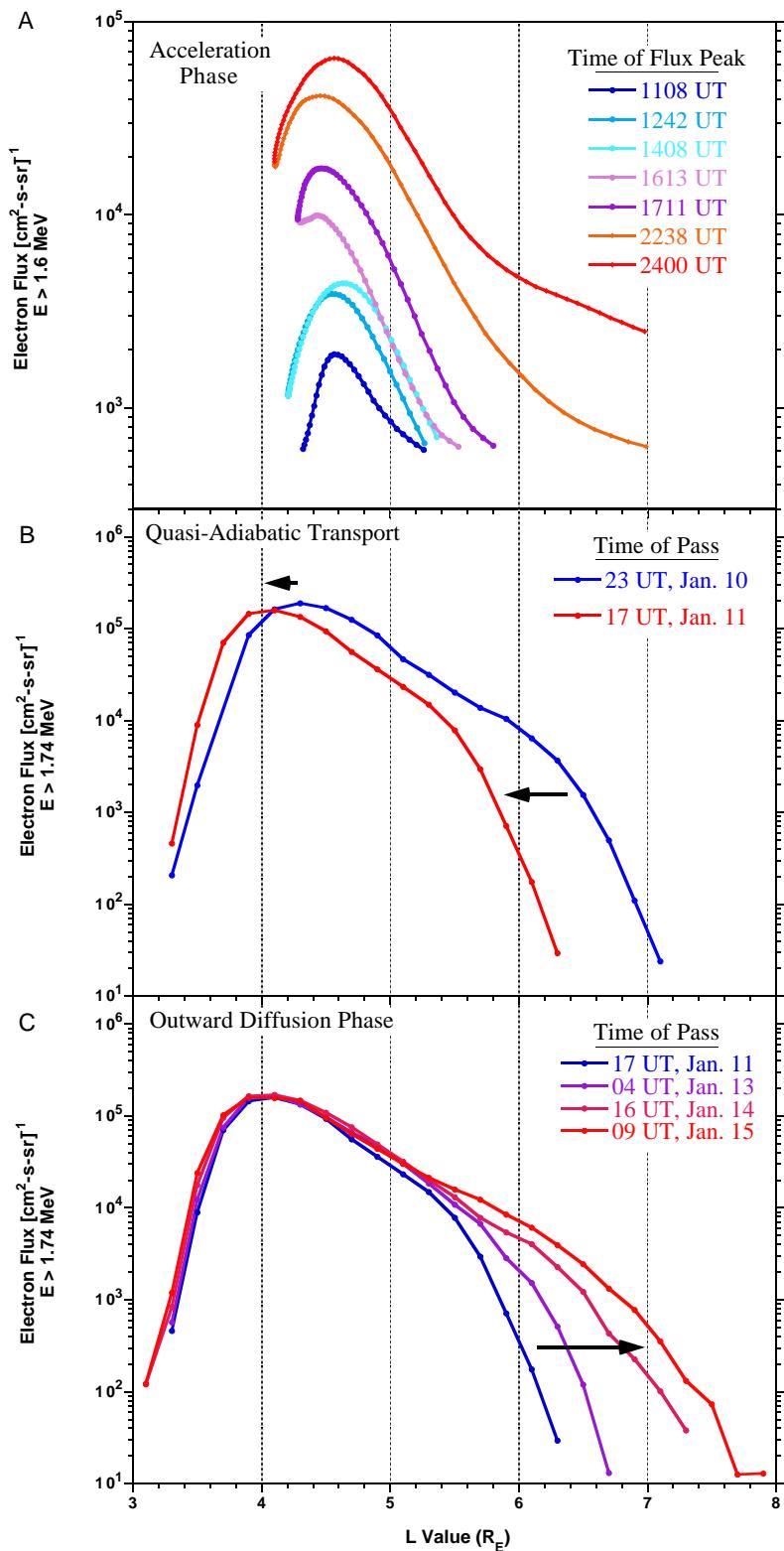


Figure 2
Reeves et al.
"Relativistic Electrons"

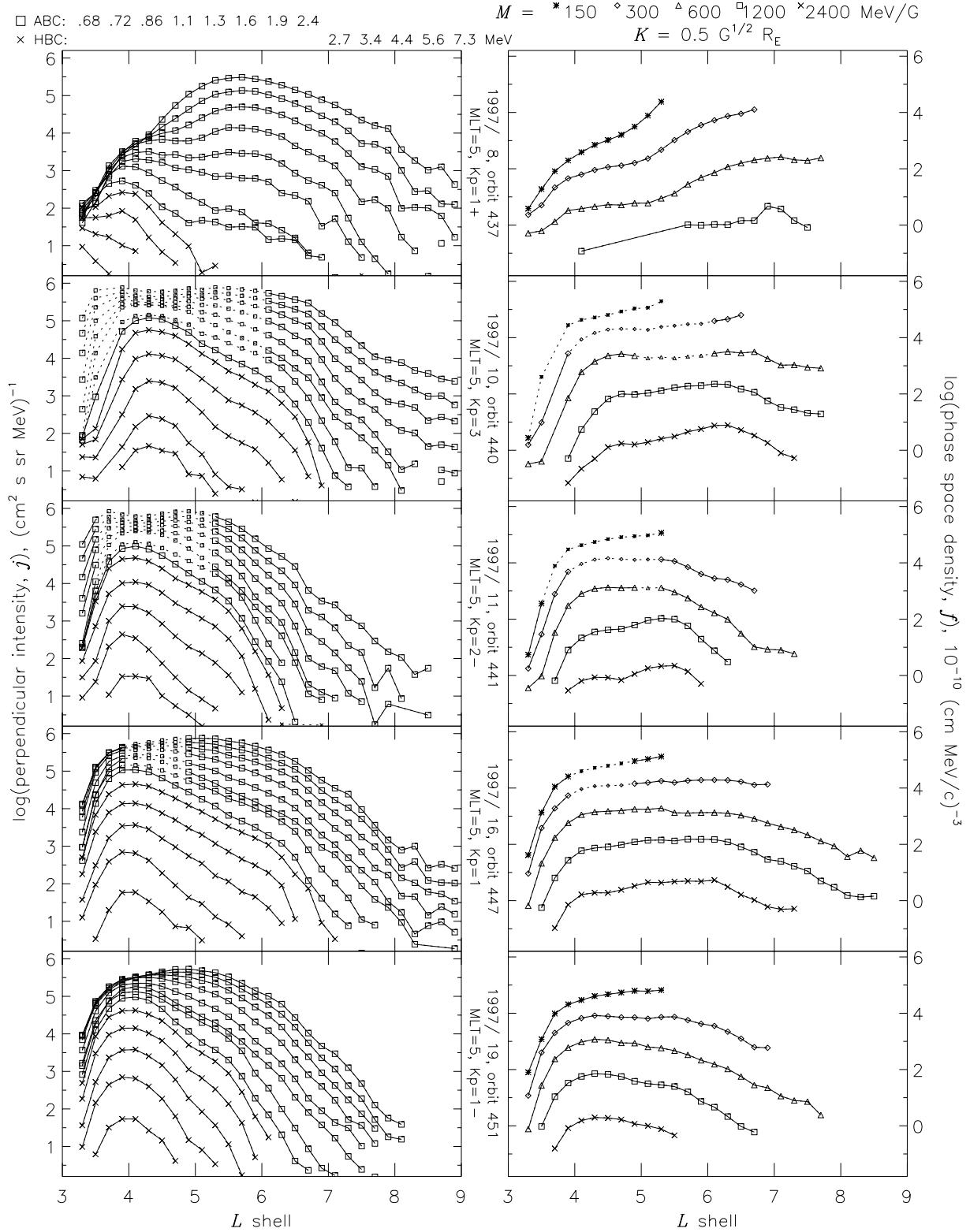
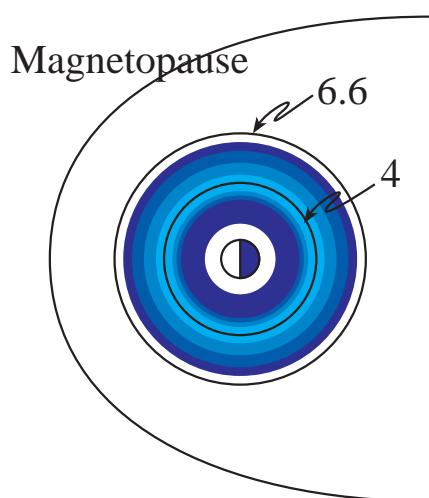
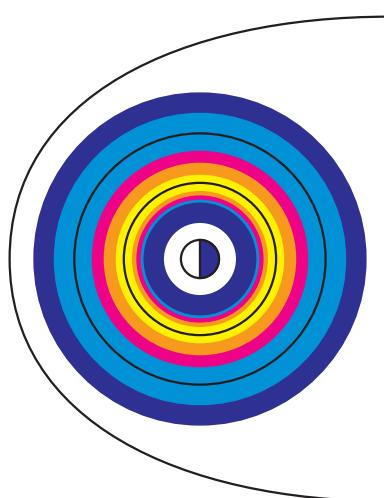
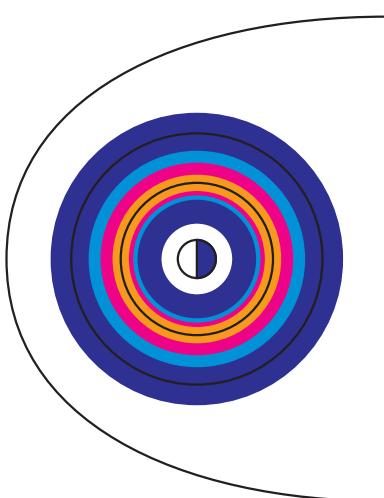


Figure 4. Electron intensity j (left) and phase space density f (right) versus L for selected orbits. The j are at 90° local pitch angle and for the kinetic energies listed at the top. The f are at the listed M and K adiabatic invariant values, with different symbols for each M value. Dashed line segments with smaller symbols represent lower limits due to instrument saturation. Average K_p and magnetic local time (MLT) values for each orbit are shown between the j and f plots.

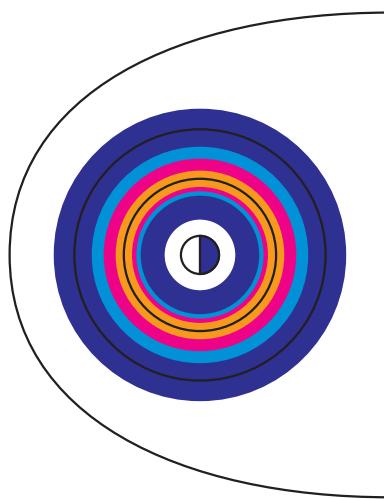
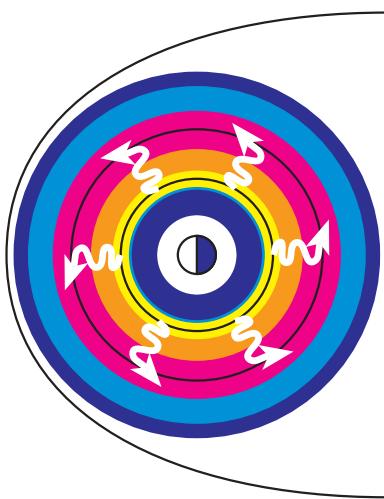
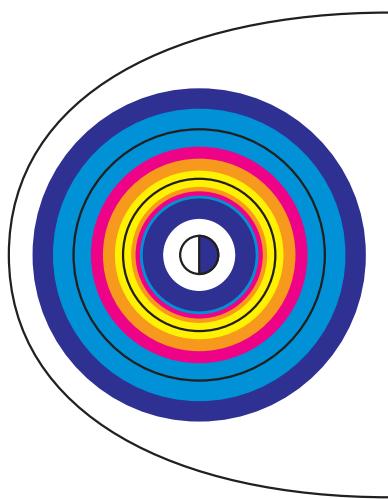
New Model of Relativistic Electron Variation



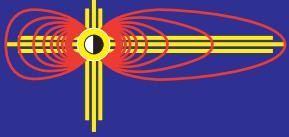
1) Injection/Acceleration



2) Quasi-Adiabatic Transport



3) Radial Diffusion and Decay



Conclusions

- Initial acceleration of >1.6 MeV electrons took 12 hours and was steady and simultaneous over $L \approx 3.5-5.5$ (Faster @ $L \approx 4$ for .4-.8 MeV - Xinlin)
- First 24-hour peak at $L=6.6$ correlates with solar wind pressure increase. L profiles show radial shift when pressure relaxes. Could be quasi-adiabatic transport.
- Second broad increase peaks Jan 15. This “typical” delayed peak is only seen in outer edge of radiation belts ($L > 5.5$). L profiles look like outward diffusion. Phase space gradient at $L > 5.5$ is consistent.
- None of these observations is consistent with the recirculation model.
- Acceleration source still unspecified. Shock may produce .4-.8 MeV electrons quickly and waves accelerate them to >1.6 MeV over next 12 hours.